

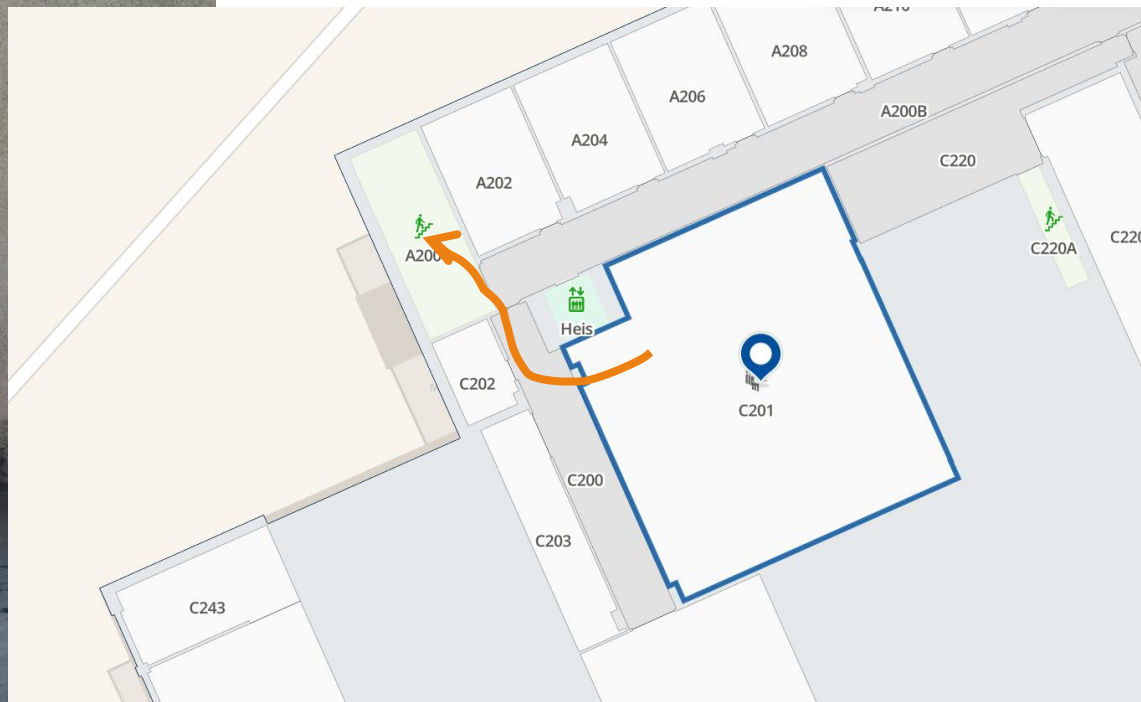
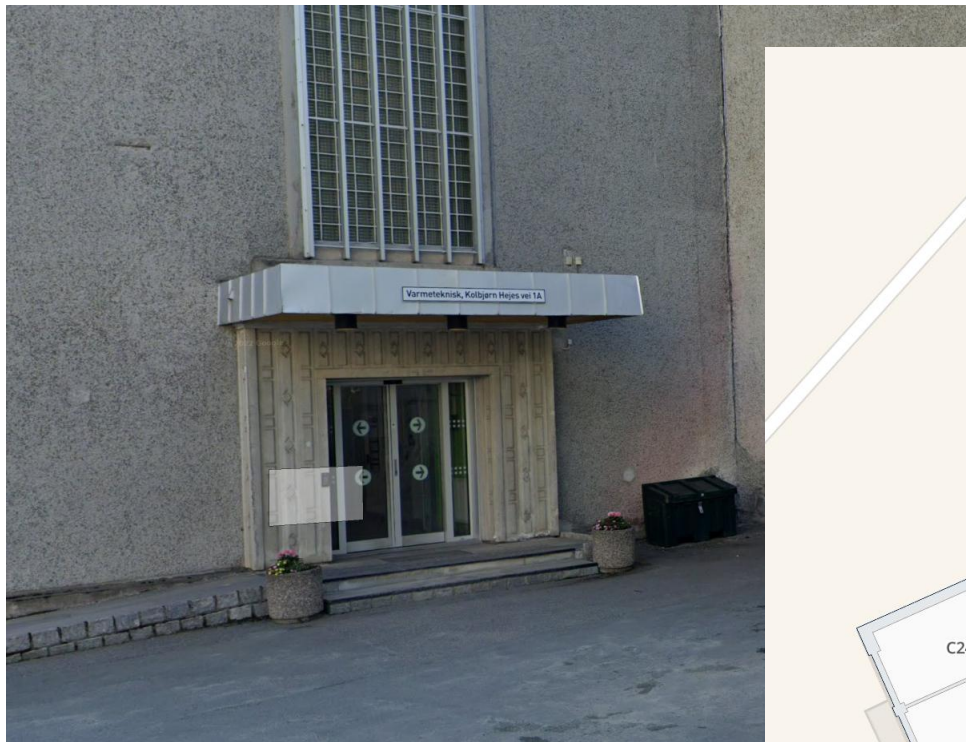


Hybrid Bergvarmepumper Workshop

Laurent Georges, Randi Kalskin Ramstad
Norwegian University of Science and Technology, NTNU
11 September 2025

Shchukin

HMS





Key technologies and demonstration of combined cooling, heating and power generation for low-carbon neighbourhoods/buildings with clean energy

ChiNoZEN



Research Centre on Zero Emission Neighbourhoods in Smart Cities
September 2020 – January 2025



The ChiNoZEN Project

WP1

Performance
of grid-
connected PVT
with TES

WP2

High
temperature
HP and
dynamic
performance

WP3

Simulation
platform and
control
strategy of
CCHP

WP4

Key CCHP
technologies
of low carbon
neighborhood
with multiple
energy sources

WP5

Demonstration
of low carbon
neighborhood
with clean
energy

Prof. Yanjun Dai



Program

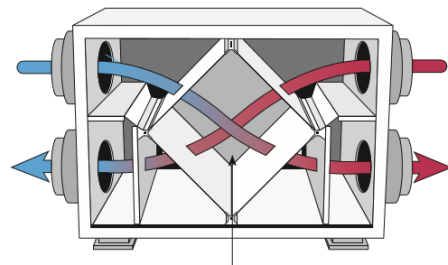


Tid	Foredragsholder	Tittel
12:00		Registrering
12:15		Introduksjon til workshopen
Part I: Temperatur regenerering		
12:30	Francisco Beltran, Hatef Madani (KTH)	GSHP + PVT: state-of-the-art og perspektiver
12:50	Jakob Jamot (DualSun Nordic)	Optimalisering av borehullskostnader, arealbruk og ytelse med PVT
13:10	Mohammad Liravi, L. Georges (NTNU)	Sammenligning av ulike varmekilder for å supplere bergvarmepumper
13:30	Trond. T. Harsem (NorConsult)	Optimalisering av borehullsfelt for hybrid bergvarmepumpe med tørrkjøler og ventilasjon
Break: 20 min		
14:10	Kirsti Midttømme (NORCE)	Solassisterte bergvarmepumper (SAGSHP): Eksempler på installasjoner i Norge
14:30	Bjørn Jenssen (SKANSKA)	Et neste generasjons, høyeffektivt termisk energisystem for energi-positive bygninger
14:50	Jianhua Fan (DTU)	Eksperimentell undersøkelse på solassisterte bergvarmepumper med horisontal kollektorslange
Part II: Høytemperatur termisk energilagring (HTES)		
15:10	Randi. K. Ramstad, Henrik Holmberg (AsplanViak)	Hovedprinsipp, GeoTermos-konsept og bruk
15:30	Ali P. Ahmadiyan, N. Nord (NTNU)	Vurdering av borehullsdimensjonering og integrasjon med fjernvarme: En casestudie i Trondheim
15:50		Konklusjon og avslutning

Hybrid Bergevarmepumpe



Luft-til-vann varmepumpe, tørrkjøler



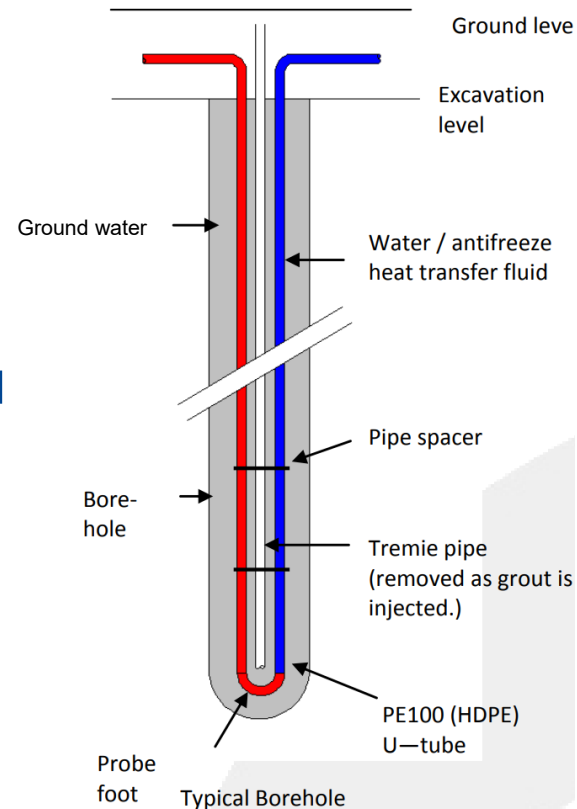
Ventilasjonsluft



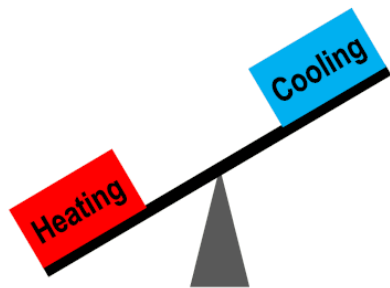
Fjern/nærvarme



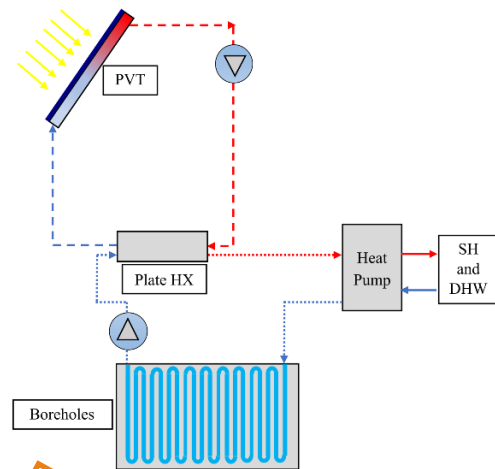
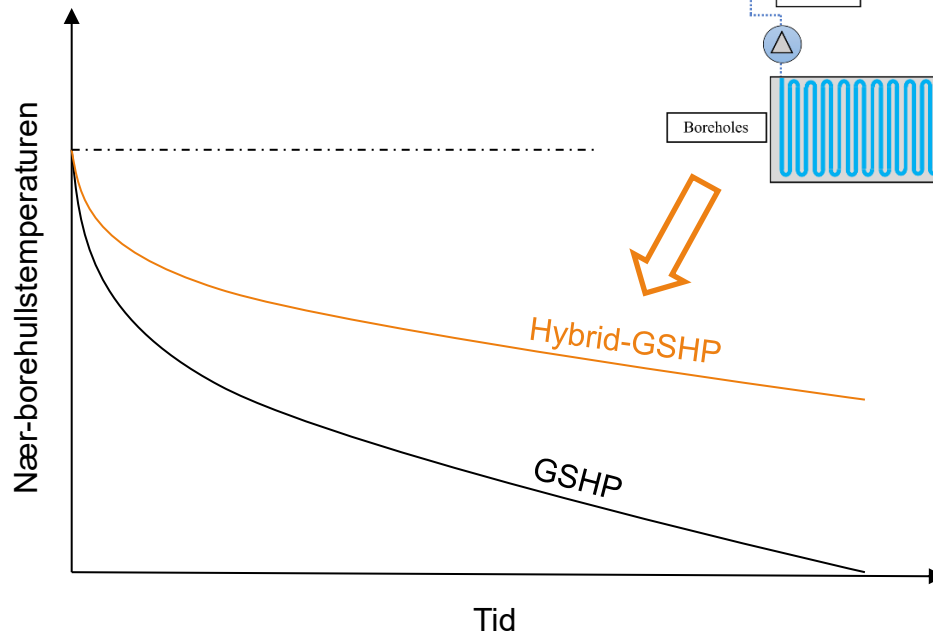
Solfanger - PVT



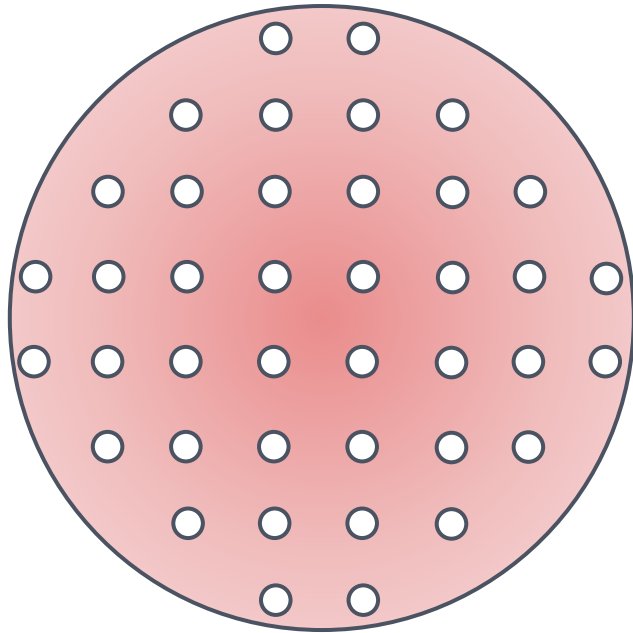
Regenerere Grunntemperatur



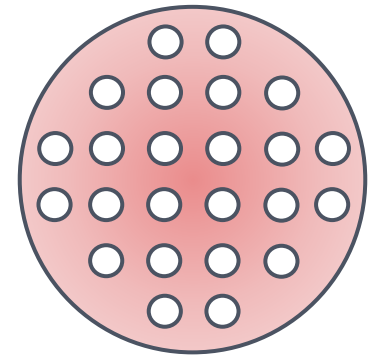
Netto varmeuttak
fra bakken



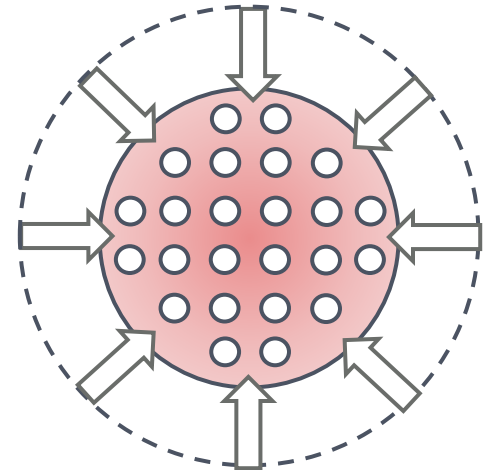
Regenerere Grunntemperatur



Maksimere den naturlige regenereringen av grunntemperaturen



Redusere antall borehull

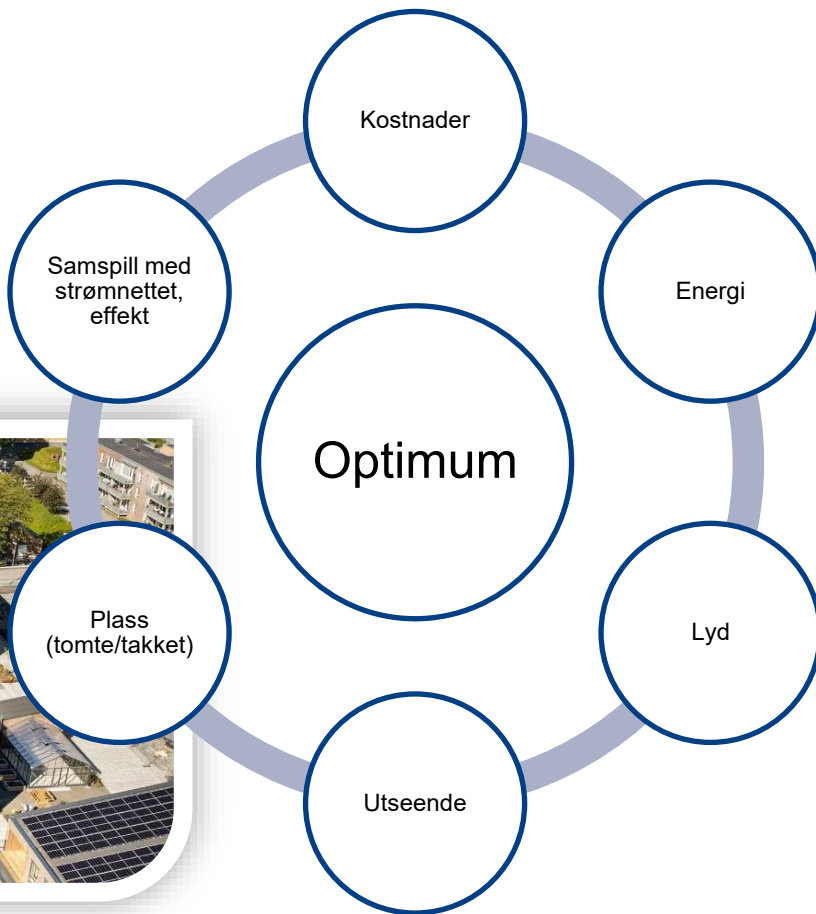


Tettere plasserte borehull

Regenerere Grunntemperatur



PowerHouse Gartnerstletta, SKANSKA, 2024



Høytemperatur Termisk Energilagring

Netto varmetilskudd til bakken

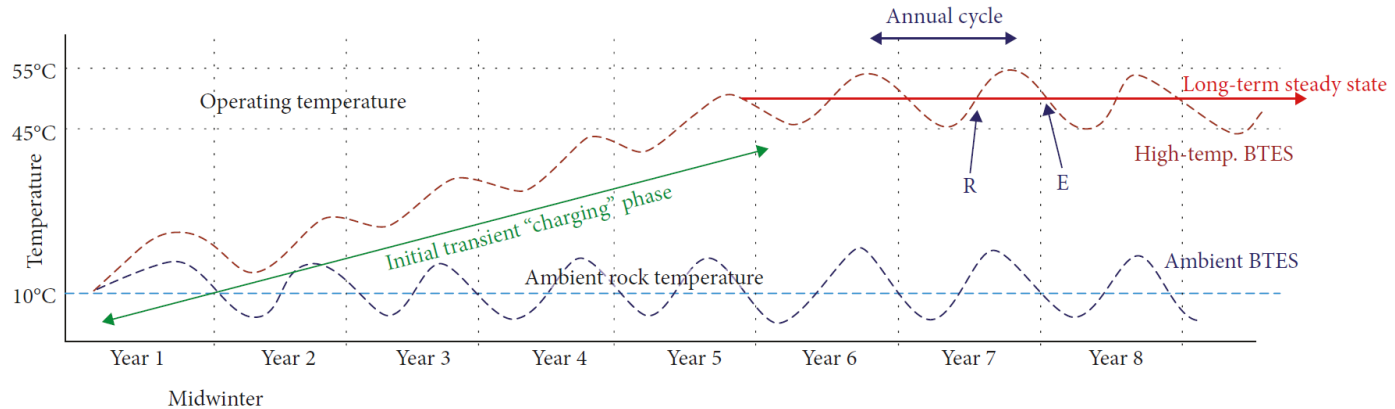
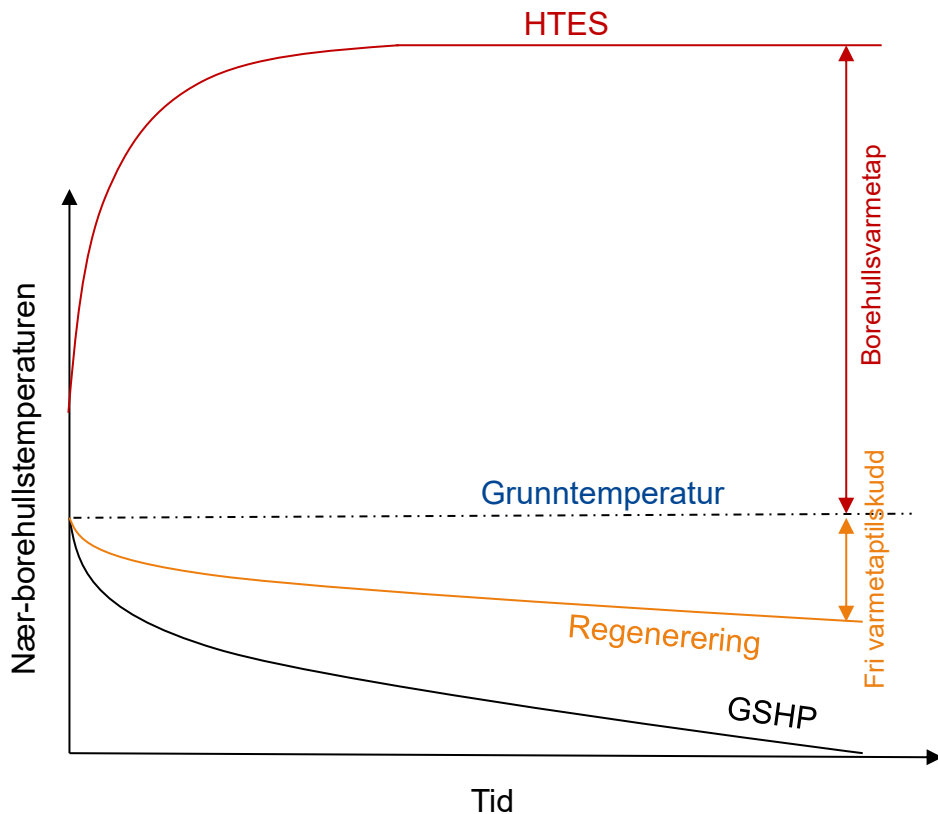


FIGURE 1: Schematic diagram of temperature evolution in a high-temperature BTES system, operating at around 45–55°C, and in an ambient BTES system serving balanced heating and cooling demands. Ambient rock temperature = 10°C. Temperatures are only indicative and will depend on exactly where within the BTES they are measured. R = recharge of heat during summer and autumn; E = extraction of heat in winter and spring.

H. Skarphagen, et al. in Geofluids, 2019

Sammenligning



Netto varme til bakken



Netto varmeuttak fra bakken



Begge er energieffektive, men det er stor forskjell på strømforbruket om vinteren.

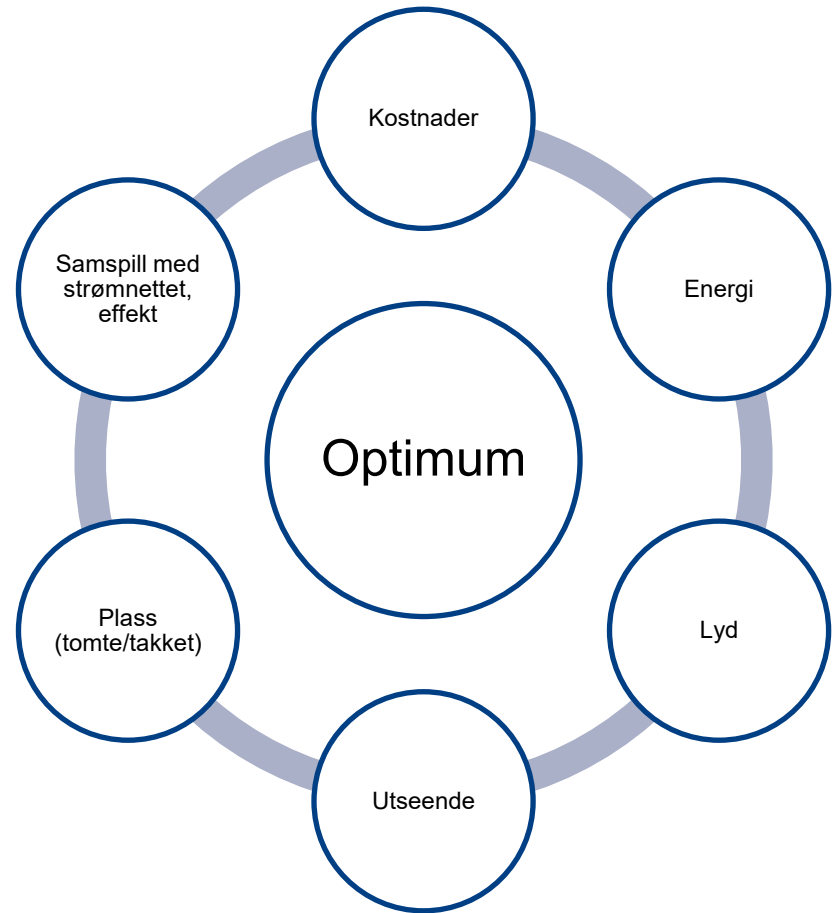
Ekstremt lav

Høyere om vinteren



Enjoy!

Hybrid bergvarmepumper åpner for nye muligheter





Takk